



Decision Centered Design

Overview & Background

Space and Naval Warfare Systems Center - San Diego
(SSC-SD)

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The DCD Problem

(and Promising Lessons Learned)

- ◆ Tactical decision makers are faced with too much *data* - not enough *information*.
- ◆ Stress exacerbates the problem.
- ◆ Reduced manning requirements, complex mission requirements, etc. further exacerbate the problem.
- ◆ *TADMUS, et al. demonstrated that effects of stress can be dramatically mitigated through:*
 - *User / decision-maker centered design*
 - *Decision support technologies*



DCD Project Objectives

- ◆ **To meet the Navy's Needs, the DCD project must:**
 - Develop a design process.
 - Evaluate the design process:
 - Training
 - Manning
 - Doctrine
 - Establish entry & exit criteria for program managers.
 - Adapt TADMUS tools and methodologies for other users, e.g. CJTF, AADC, CVBG, etc.
 - Research, identify, integrate and leverage other enabling decision support technologies.
 - Integrate decision support technologies with current Navy C4I & combat system infrastructure.



DCD Background

- ♦ **Mar 96: Brief of TADMUS to SSG XVI**
- ♦ **Jan 97: SSG XVI concept brief to CNO / VCNO / N6 / N6M - *Command 21/Speed of Command*.**
- ♦ **July 97: CNO approved concept implementation; OPNAV N6 assigned sponsorship. Plan approved for POM 00.**
- ♦ **Oct 97: N6 / N8 Implementation Plan Review**
- ♦ **Dec 97: CNO Approval & Funding Search**
- ♦ **Jan 98: FY98 Funding Identified / Reprogrammed**
- ♦ **Jan 98: PMW 133, designated program manager.**
- ♦ **April 98: Funding received at SSC.**



SSC Technical Tasks – FY98

- ◆ **Develop DCD orientation course for Program Managers. (SSC, PSE, Orincon)**
- ◆ **Brief DCD project & identify claimant and acquisitions. (PMW-133, SSC)**
- ◆ **Conduct cognitive task analyses for CJTF & AADC. (Klein Associates)**
- ◆ **Develop criteria and guidelines for DCD process. (SSC, PMW-133, PSE)**
- ◆ **Develop a DCD implementation & test facility upgrade plan. (SSC, PSE)**
- ◆ **Establish general-purpose capability for DCD prototypes to use real tactical data links. (SSC, DTAI, Litton-PRC)**
- ◆ **Develop baseline prototype for CJTF position. (PSE)**



New Cultural Approach

Cognitive Task Analysis & NDM

Presentation Technology

?? Information Requirements

Knowledge & Expertise ??

Training & Doctrine

Information & Decision Theory

Stressors:
Time Pressure
High Stakes
Uncertainty
Must do something



Decision Requirements

Decision Centered
system design

+

Decision Centered
training

+

Decision Centered
organization

Improved
Decision
Making
&
Reduced
Manning



Status of Command 21 - Decision Centered Design (DCD) Initiative

- ◆ **Sponsor: U.S. Navy (N6M) - 6.4 funded.**
- ◆ **Objectives:**
 - Develop DCD process for use across Fleet C4ISR systems.
 - Develop DCD laboratory and expertise.
 - Perform Cognitive Task Analyses on AADC, CJTF, CVBG.
 - Develop decision support concepts for various Joint / Fleet Applications.
 - Integrate decision support concepts with C4I architecture.



Status of Command 21 - Decision Centered Design (DCD) Initiative (*continued*)

- ◆ **Status: Funded as FY98, 4-Yr., 6.4 Task**
- ◆ **P.O.C.: J.Morrison, Ph.D.; SPAWARSYSCEN Code D44210. (619) 553-9070**
- ◆ **Relationship:**
 - Responding to Fleet reduced manning initiatives.
 - Leveraged off on-going TADMUS 6.2 / 6.3.



Part II: Tactical Decision Making Under Stress (TADMUS)

<http://www-tadmus.spawar.navy.mil>

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TADMUS Background

- ◆ **Office of Naval Research 6.2 applied research program responding to USS Vincennes shootdown.**
- ◆ **A bridge between emerging cognitive theories / models and Navy C⁴I requirements.**
- ◆ **Development of Decision Support System (DSS) to supplement & improve command decision making.**
- ◆ **Transitioned to 6.3 advanced development program with CCG1/N88/ COMTHIRDFLT endorsements. Currently initiating systems integration to tie DSS to C4I and combat systems.**

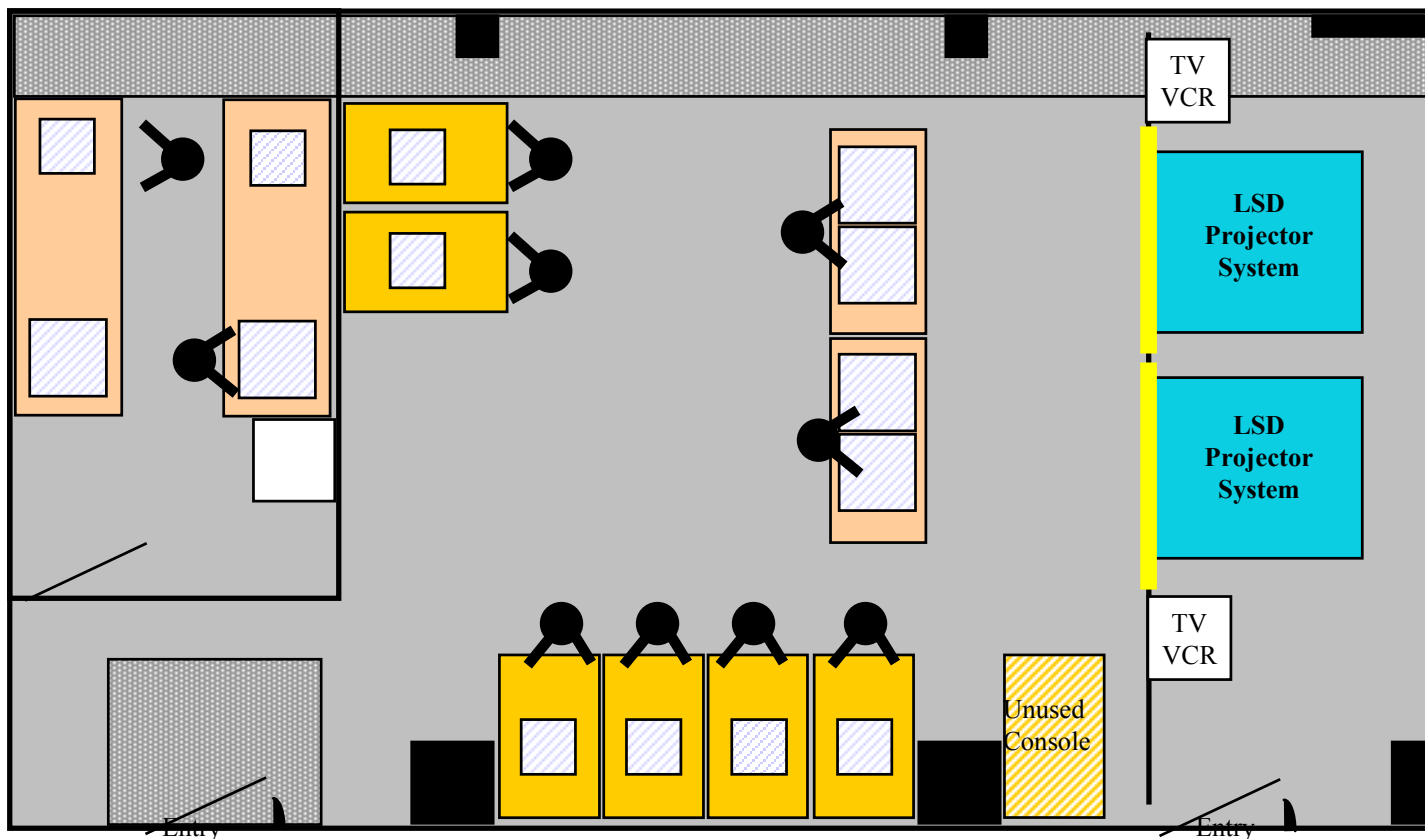


DEFTT Laboratory - TADMUS Configuration

Control/Observation Room

Main Room

Projector Room



Building A33, Room 0418 Scale: 1" = ~4'



What TADMUS is about:

- ◆ **Understand the effects of combat conditions on decision-making.**
 - Time Pressure
 - Ambiguity, Uncertainty
 - High Stakes
- ◆ **Develop the “naturalistic” decision-making framework - apply it to interface, decision support and training concepts.**
- ◆ **Prototype and evaluate interfaces & decision support tools.**
 - “Decision Support System” (DSS)
- ◆ **Revise & Iterate to better and better performance**



What TADMUS is NOT About:

- ◆ **Reducing combat stress.**
- ◆ **Criticism of Aegis or other systems.**
- ◆ **Decision-making by computer.**

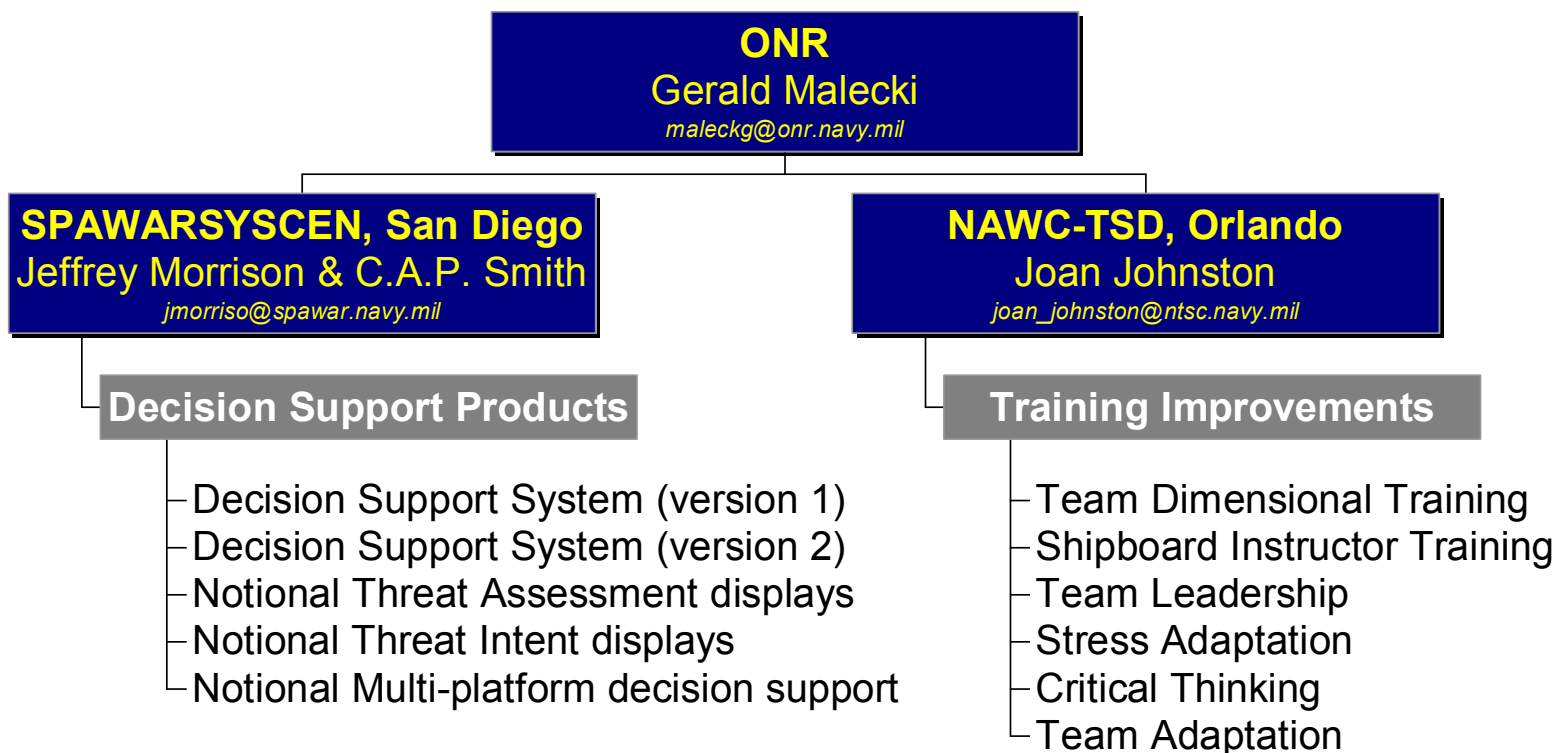


Research Through the Years

- ◆ **Research on tactical decision strategies**
 - Klein Associates
 - Engineering Research Associates
 - Chi Systems
 - Decision Research, Inc
- ◆ **Research on human information processing biases**
 - McDonnell Douglas
 - Cognitive Science, Inc
- ◆ **Human-Computer Interaction**
- ◆ **Artificial Intelligence/Neural Networks**
 - SDSU
- ◆ **Decision Metrics**
 - Orincon



Current Project Organization





Naturalistic Decision Making

- ◆ **Experts make decisions differently from novices.**
 - Experts use heuristics as decision making shortcuts.
 - Recognition-Primed Decision Making
 - Explanation-Based Reasoning
 - Heuristics lead to *biases* & can cause *error*.
 - Framing
 - Anchoring
 - Confirmation
- ◆ **Stress Affects Performance.**
 - Hypervigilance (Impulsive action)
 - Intolerance of ambiguity
 - Fixation on primary task / Tunnel vision
 - Less communicative
 - Short-term memory degradation



Range of Expertise Critical to Success: TADMUS Project Team

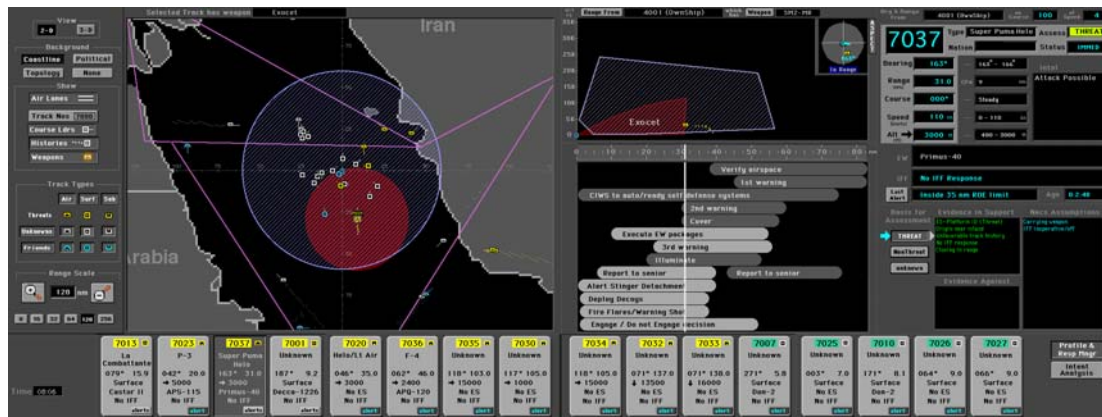
◆ Operational Expertise

- CO, NTU Cruiser; CO, Tactical Training Group Pacific; Commander & Chief of Staff, Carrier Group ONE
- CO, Aegis Cruiser; N8, Warfare Requirements, Readiness & Training, COMNAVSURFPAC; N1, Manpower, Personnel & Training, COMNAVSURFLANT
- CO, Fleet Combat Systems Training Unit Pacific; Officer In Charge, COMNAVSURFPAC Combat Systems Assessment Team; Combat Systems Officer, Afloat Training Group Pacific

◆ Research Expertise

- Engineering Psychologist, 10+ Years experience: aviation, advanced automation, decision aiding, cognition, system engineering.
- Engineering Psychologist, 20+ Years experience: C4I, RDT&E, personnel selection & training, display design, cognition.
- Decision Scientist, 20+ Years experience: Decision Support, information systems design, time pressure.

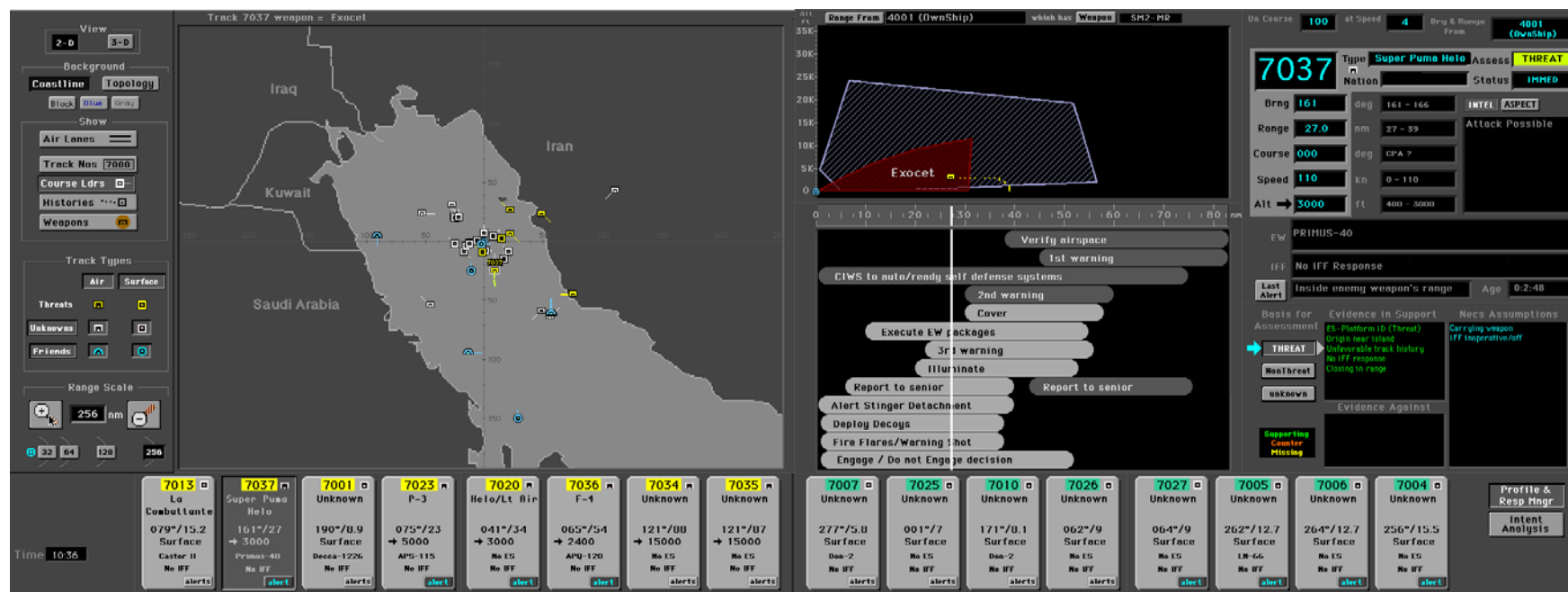
◆ Fleet Participation





Decision Support System - 2

- Product of TADMUS applied research project.
- Designed for Command decision makers aboard surface combatant.
- Represents decision support concepts embodied in working code - Not a functional system.





TADMUS DSS Studies

Are we on the right track with DSS?

◆ Objectives:

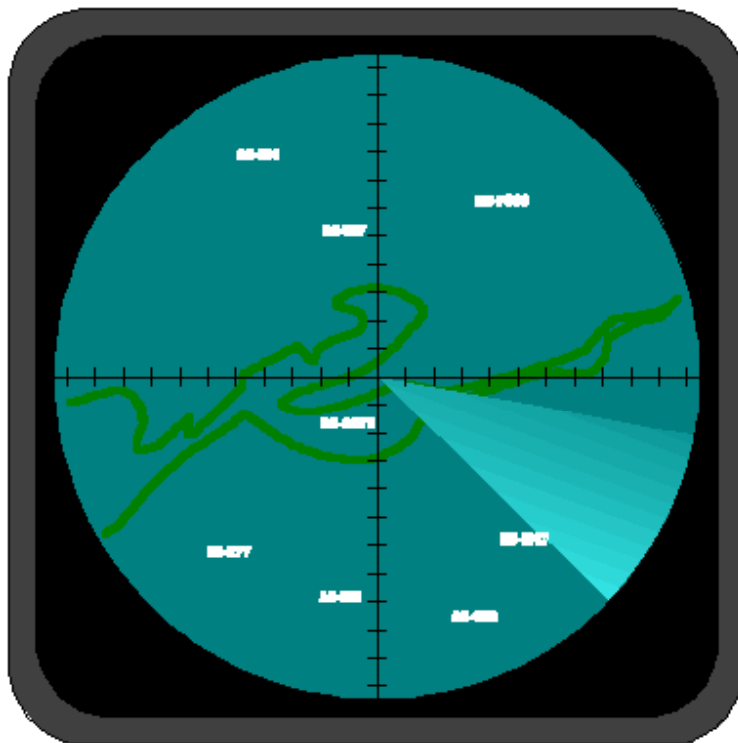
- Determine overall effects of DSS
- Examine the use of DSS modules

◆ Research Questions:

- Situation Awareness
- Communications
- DSS Utility
- DSS Usability



Situation Awareness

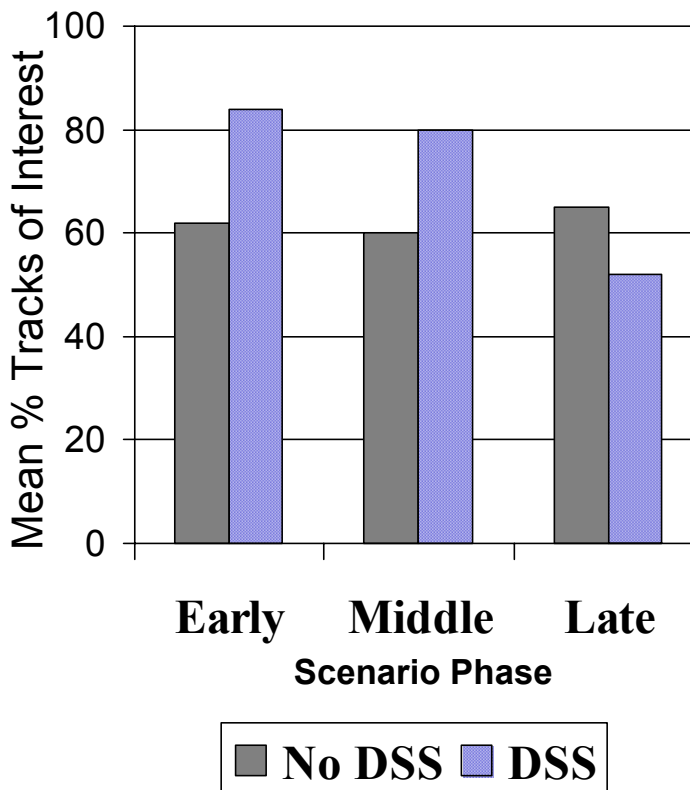




Do teams recognize more critical contacts when using DSS?

- ◆ **More tracks of interest were reported at early and at middle probes.**
- ◆ **No difference at late.**
End-game more obvious.
- ◆ **Most felt a positive effect of DSS. (5.78 of 7-points)**

“more confident of my grasp of the overall tactical picture and priority threats”





Do teams take more of the required actions against threat tracks with DSS?

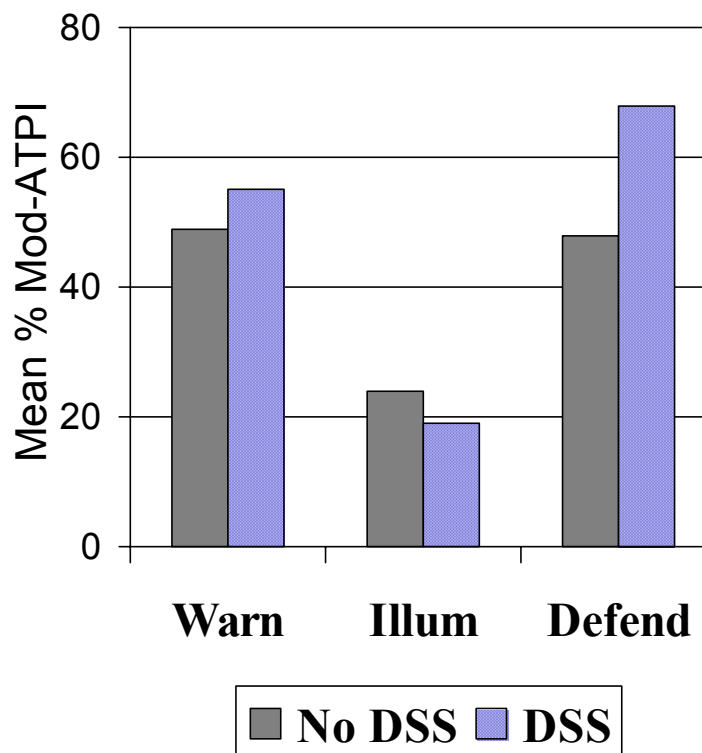
- ◆ **Significantly more likely to take timely defensive measures.**

Track Profile

Response Manager

- ◆ **No difference in warnings and illuminations (provocative actions).**

Note: Improved SA is reflected by taking less provocative actions earlier and more provocative actions later for a track.





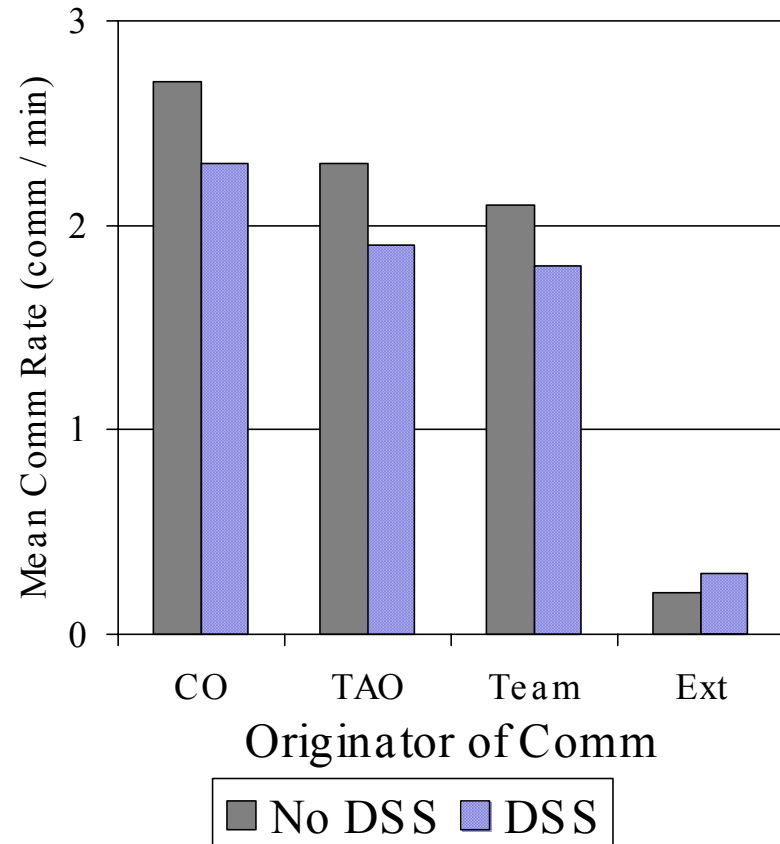
Team Communications





Does the rate of communications change when using DSS?

- ◆ **Significantly fewer communications / min. overall with DSS (7.3 vs. 6.3).**
 - less need to exchange or verify data verbally
- ◆ **Consistent effect for all originators of messages.**





Content Coding Categories

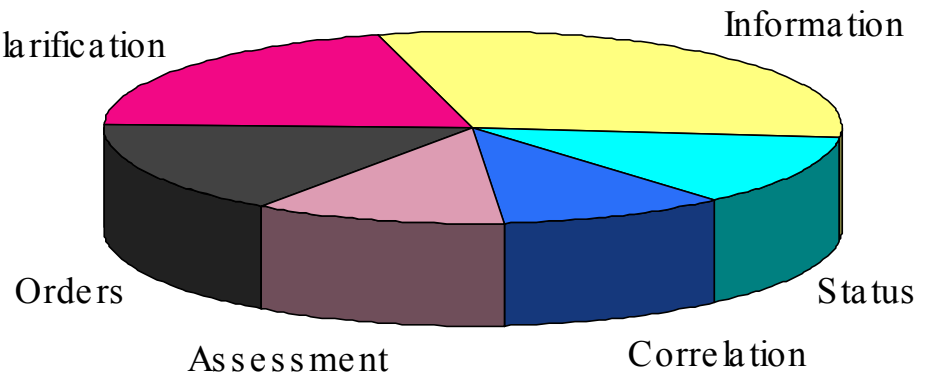
- ◆ ***Information*** – exchange of sensor-based data
- ◆ ***Status*** – exchange of procedure-based data
- ◆ ***Correlation*** – association of two or more data
- ◆ ***Assessment*** – discussion of expected track behavior, likely intent, or future actions
- ◆ ***Orders*** – commands to perform an action
- ◆ ***Clarification*** – efforts to elucidate, interpret, or correct other communications

Inter-rater reliability (3 raters): kappa = .92



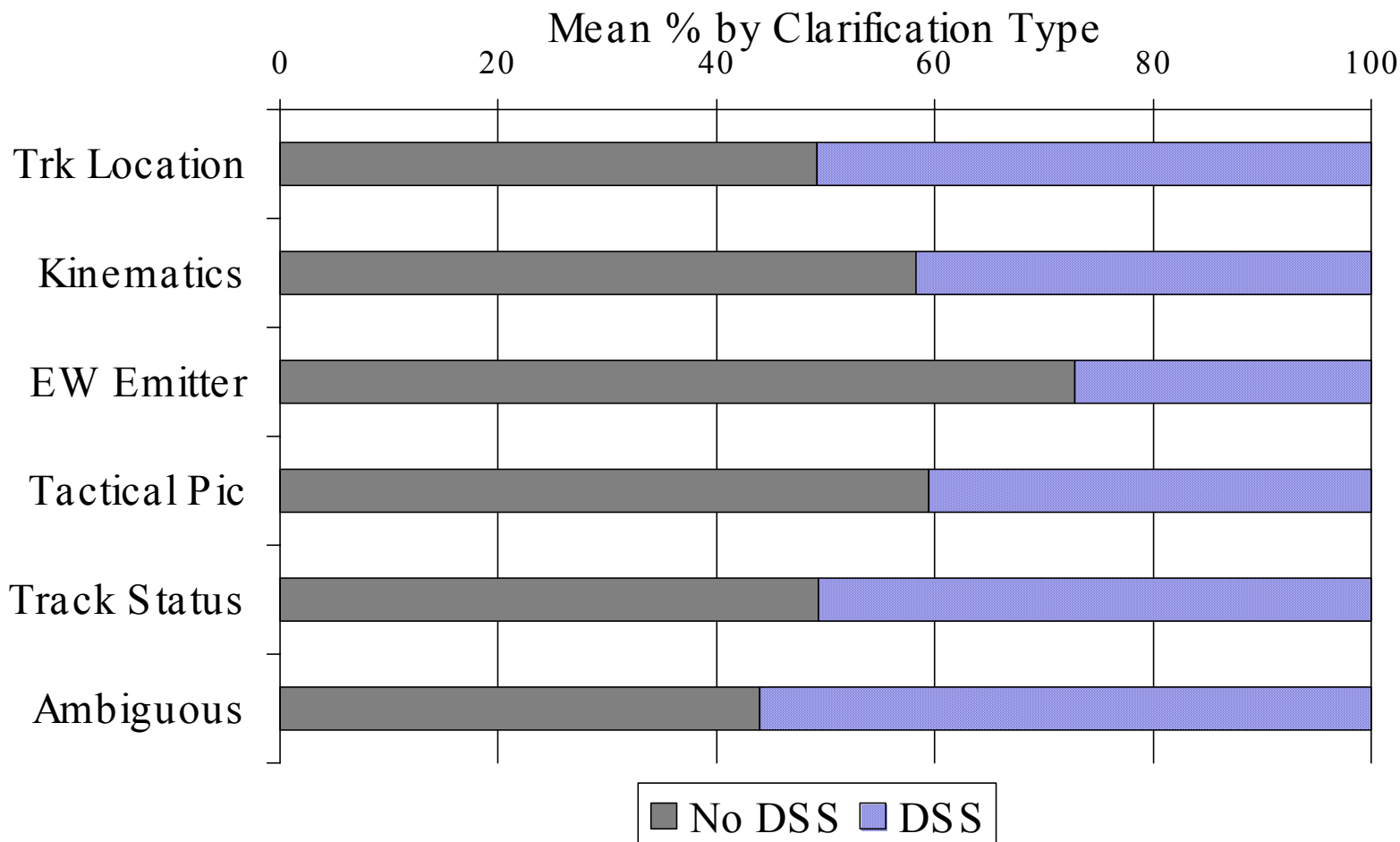
A Glimpse Into DEFTT Lab Team Communications

- ◆ **Most comms (30%) involve exchange of sensor data.**
- ◆ **About 20% of comms involve Clarifications.**
- ◆ **Remaining comms involve other issues related to track management.**
- ◆ **Results are relatively consistent across teams and scenarios.**





How does DSS affect clarifying communications?





DSS Studies - Conclusions

- ◆ **CO and TAO use the DSS frequently.**
- ◆ **DSS is considered useful and adds value.**
- ◆ **Fewer communications and fewer of certain types of clarifications with DSS.**
- ◆ **More of the critical contacts recognized earlier.**
- ◆ **More likely to take defensive measures.**
- ◆ **DSS is easy to understand and use.**
- ◆ **Many valuable suggestions for revising DSS.**



TADMUS Flag Briefings

- ◆ **VADM Fargo, COMFIFTHFLT**
- ◆ **VADM Hancock, OPNAV(N4)**
- ◆ **VADM Krekich, COMNAVSURFPAC**
- ◆ **VADM Browne, COMTHIRDFLT**
- ◆ **VADM Lautenbacher, COMTHIRDFLT**
- ◆ **ADM Hogg, Director Strategic Studies Group**
- ◆ **RADM Wagner, SPAWAR**
- ◆ **RADM Nutwell, Deputy SPAWAR**
- ◆ **RADM Long, COMCRUDESGRU FIVE**
- ◆ **RADM Marfiak, COMCRUDESGRU FIVE**
- ◆ **RADM McGinn, OPNAV N88**



Direct Flag Support

- ◆ **VADM Browne, COMTHIRDFLT**
 - Ongoing supporter
- ◆ **VADM Lautenbacher, N8**
 - Endorsement of 6.3 TADMUS to Sea as COMTHIRDFLT
- ◆ **ADM Hogg, Director Strategic Studies Group**
 - Command 21 / DCD
- ◆ **RADM McGinn, Prospective COMTHIRDFLT**
 - Endorsement of 6.3 TADMUS to Sea as N88



TADMUS Summary

- ◆ **ONR approved a 3-year 6.2 follow-on project starting FY97.**
 - Develop integrated training & decision support interventions (e.g. Wizards, Tutorials, embedded scenarios)
 - Support SWOS PCO/PXO/Department Head tactical decision making requirements
 - Delivering DSS for scenario support and staff/student evaluation
 - Extend DSS to other AW positions within CIC (AWC , TIC , EW)
 - Extend DSS to other warfare areas in CIC (SUW, USW)
 - Apply emerging Decision making theories to CIC problems
 - Develop improved metrics / methodologies for measuring tactical decision making (e.g. real-time performance assessment, eye movement, communication analyses, etc.)



Response Planner & Manager Project (RPM) Summary

- ◆ **Customer: U.S. Navy (Battlegroup)**
- ◆ **Objectives:**
 - Analyze and develop cognitive models of military tactical planners & planning process.
 - Develop customized interfaces to:
 - perform pre-deployment planning and real-time re-planning of battle force assets (*author and tailor specific action plans*)
 - perform tactical resource/response management based on established plans (*plan execution and monitoring*)
- ◆ **Status: Funded as FY97, 3-Yr., 6.2 HF Task.**
- ◆ **P.O.C.: C.A.P. Smith; Code D44210, (619) 553-5411**
- ◆ **Relationship:**
 - Inspired by TADMUS DSS Response Manager & Collaborative planning needs. Marines looking for similar tools.
 - Planning and Execution decision modeling.



Basis for Threat Assessment Summary

- ◆ **Customer: U.S. Navy (Battlegroup)**
- ◆ **Objectives:**
 - Develop Threat Assessment Algorithm for AW Task
 - Improve Threat Display
- ◆ **Status: Seed Funding in FY99, Planned New Start in FY00**
- ◆ **P.O.C.: C.A.P. Smith; Code D44210, (619) 553-5411**
- ◆ **Relationship:**
 - Inspired by TADMUS DSS.
 - Required for RPM module response set selection.
 - Required for TADMUS mini-CRO priority ranking.



TADMUS to SEA Summary

- ◆ **Customer: U.S. Navy (COMTHIRDFLT, DD21 / MMWS)**
- ◆ **Objectives:**
 - Develop Tactical Fleet Command Center DSS application.
 - Mature underlying DSS algorithms / databases.
 - “DSS@Sea” shipboard evaluation.
 - Integrate decision support concepts into JMCIS
- ◆ **Status: Funded as FY97, 4-Yr., 6.3 Human Factors Task**
- ◆ **P.O.C.: J.Morrison, Ph.D.; SPAWARSCEN Code D44210. (619) 553-9070**
 - Develop mature components of TADMUS DSS & build into combatant.
- ◆ **Relationship:**
 - Responding to Fleet requests to implement DSS onboard ship & extend DSS to battle group command level.
 - Leveraged off on-going TADMUS 6.2.



Part III: Decision Centered Design Lessons Learned.

Preliminary Observations of C2F & C3F JOC and BWC and Staff.

- *Hunter Warrior 97*
- *Fleet Battle Experiment Charlie 98*
- *JTFEX aboard USS Coronado*
- *RIMPAC 98*
- *“JTFEX” aboard USS Mt. Whitney*
- *Misc. Visits, Interviews, Correspondance, etc.*



CTA Results to Date

- ◆ **Identify roles & functions**
 - Communication Patterns
 - Information Sources
- ◆ **Search for the hard cognitive problems**
 - Evidence of loss of Situation Awareness
 - Breakdowns in teamwork
 - “Tipper” information
 - Strategies for off-loading of tasks
- ◆ **Observed critical incidents, routine tasks, interruptions, barriers.**



CTA Lessons Learned

- ◆ C2F JOC / BWC operations are similar to, and quite different from C3F (e.g., NATO issue, JOC layout)
- ◆ JOC “Concept of Operations” is constantly evolving (and greatly dependant on the current exercise / operation)
- ◆ Additional data is needed (C2F / C3F staff indicated that some other fleets do things very differently)
- ◆ Direct observations during exercise / operation contribute valuable information and insights
- ◆ Formal interviews can be *very* difficult to obtain during exercise / operation
- ◆ Informal interviews can prove *extremely* valuable



The Plan From Here ...

- ◆ ***BEGIN DEVELOPMENT OF IMPROVED SYSTEMS / DISPLAYS!!!!***
- ◆ Build “Virtual Laboratory” a.s.a.p. Employ IRUS / LEIF architecture.
- ◆ Continue to collect information - C5F, C6F, C7F are appropriate and necessary candidates.
- ◆ Request ridership aboard USS Coronado and USS Mt. Whitney during upcoming events.
- ◆ Attempt in-port interviews as time and funding permit.
- ◆ Conduct occasional follow-up visits to JOCs aboard USS Coronado, USS Mt. Whitney, and others to record evolution of JOC / BWC concept of operations.



Critical Task Analysis (CTA) Observations & Interviews



Needs Identified So Far...

- ◆ **BWC needs assistance defining and displaying information to the CJTF and team dealing with operational issues**
 - Easy-to-understand “Summary” graphics
- ◆ **Need to help Anchor Desks provide “value added” information to the BWC (i.e., collaboration tools, graphical representations of relevant data)**
- ◆ **Anchor Desks need ability to effectively monitor tactical / operational displays**
- ◆ **Various equipment deficiencies (inefficient communications systems, hard to read displays, data transfer issues, etc.)**



CTA Efforts

- ◆ **Questions asked formally and informally...**
 - What is the BWC's job / role / function?
 - What does the CJTF need / expect from the BWC and his or her staff?
 - What “job smarts” have you developed to aid you in your duties as BWC?
 - What key “tipper” information do you notice while performing your duties?
 - What efforts can you “off-load” to other watch personnel? and What efforts are just too important to let someone else do?



CTA Efforts (cont.)

◆ More questions asked informally...

- What is difficult about being a BWC?
- Where does your most valuable information come from?
- If you could change your display to display anything you want, what would it be?
- Who do you communicate most with (on-ship or off-ship)? and What information do you exchange with this person?
- What distracts you when the workload is high?
- What is the most difficult aspect of your job, especially with respect to decision-making?



What is the BWC's job / role / function?

- ◆ **“Work the seams” between Component Commanders**
- ◆ **Monitor the tempo of the campaign**
- ◆ **Gather, analyze, fuse, and disseminate operational data. (Build and maintain S.A.)**
- ◆ **Assist component commanders with resource conflicts, etc.**
- ◆ **Advise the Admiral on operational issues.**
- ◆ **“Represent the Admiral” during day-to-day operations...**



What does the CJTF need / expect from the BWC and his or her staff?

- ◆ **To be advised immediately regarding any of his numerous CCIRs or non-compliance with operational guidance (Commander's Intentions, etc.)**
- ◆ **An up-to-date situation awareness.**
- ◆ **A clear understanding of past, current, and future ops.**
- ◆ **A “concept of ops” / recommendations regarding how to proceed on various matters.**



What “job smarts” have you developed to aid you in your duties as BWC?

- ◆ **Formal watch turnover briefs starting 30 minutes prior to the watch to ensure that off-going and on-coming watch personnel (and any other interested personnel) have a common understanding of the situation and the commander’s intent.**
- ◆ **Maintain close working relationships with other JOC personnel and embarked component commander staff.**
- ◆ **Making effective use of MS Office.**



What key “tipper” information do you notice while performing your duties?

♦ Various indicators...

- “Everything...”
- “Reports from other ships”
- “Input from Intell”
- “Heads up from other ship’s assets”
- “Voice traffic on the command circuit”
- “J7 (white cell) personnel comments”
- “Significant air activity”



What efforts can you “off-load” to other watch personnel? and What efforts are just too important to let someone else do?

- ◆ *Most felt that the current watch structure and SOP (Standard Operating Procedures) had already allocated job tasks appropriately. In other words, the tasks that they were assigned should be performed by them... They did not feel that it was appropriate to off-load tasks. The only exception to this was that the BWC and Assistant BWC often task-shared.*



What is difficult about being a BWC?

- ◆ **Developing and maintaining S.A.**
- ◆ **Working with time-late information.**
- ◆ **Being informed of important information by tactical units “after-the-fact.”**
- ◆ **Information “disconnects” with component commander cells aboard ship and on other units.**
- ◆ **Preparing briefs difficult and inefficient.**
- ◆ **Difficult to maintain consistent quality / quantity in log.**
- ◆ **Too many comms circuits to handle** (*secure nets, unsecure nets, secure phone, unsecure phone, e-mail, etc.*)



Where does your most valuable information come from?

- ◆ **Intelligence Anchor Desk / LNO**
- ◆ **Air and Ground LNOs**
- ◆ **Voice traffic across the command nets and secure phones**
- ◆ **JAG (Judge Advocate General, i.e., Legal LNO)**



If you could change your display to display anything you want, what would it be?

- ◆ **Current information...**
- ◆ **More information... (*however, they weren't sure what else they would want..*)**
- ◆ **Composite “cartoon” / Operational Graphic representing S.A.**



Who do you communicate most with (on-ship or off-ship)? and What information do you exchange with this person?

- ◆ **Other units in the area.**
 - Information regarding ongoing and past events.
 - Requests for direction / authorization regarding various actions.
- ◆ **Anchor Desks / LNOs (Liaison Officers) within the JOC**
 - New information, recommendations, updates, etc.
- ◆ **Representatives from other component commanders**
 - Updates regarding current and future ops.



What distracts you when the workload is high?

- ◆ **The need to get the next briefing ready...**
- ◆ **Ambient noise within the JOC**
- ◆ **Ambient temperature within the JOC**
 - A less-than-optimized A/C system resulted in a work space that was often too hot, or too cold.



What distracts you when the workload is high? *(continued)*

- ◆ **The need to monitor numerous communications circuits simultaneously**
- ◆ ***Constant* interruptions by non-watch standing personnel**



What is the most difficult aspect of your job, especially with respect to decision-making?

- ◆ **Gathering, analyzing, fusing, and disseminating all operational information available.**
- ◆ **Developing and maintaining an accurate, up-to-date S.A.**
- ◆ **Training new watch personnel and “ramping-up” staff augmentees from other units.**

Joint Operations Center (JOC) Workspaces

What we know so far...

Implications for DCD “Virtual” Laboratory ...



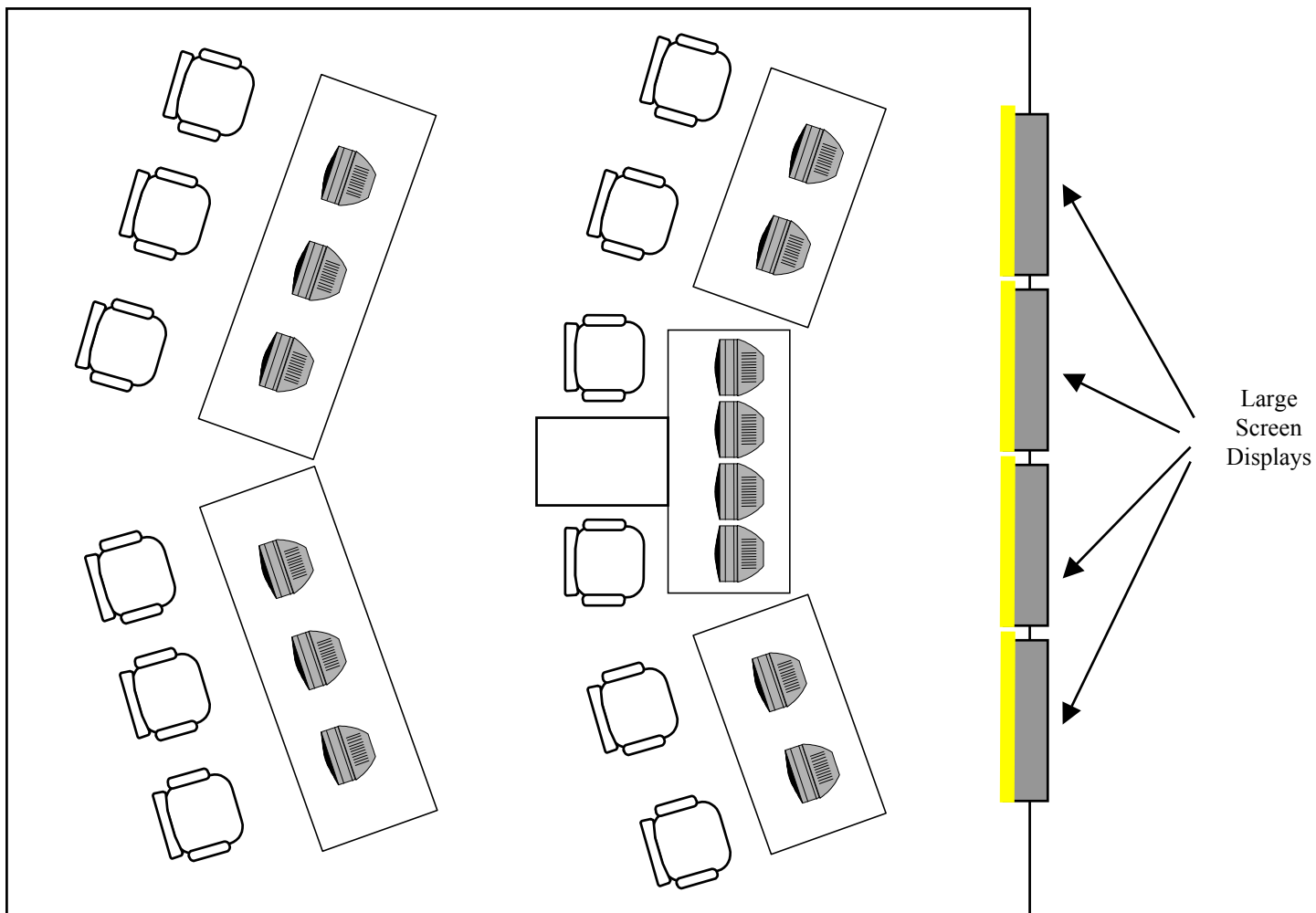
JOC Designs and Layouts

- ◆ **We currently have only four “data points” - USS Coronado pre- and post-redesign, and USS Mt. Whitney pre- and post-redesign**
- ◆ **Each is similar to, and different from the others**
- ◆ **Each “new JOC” was designed by teams made up of ship’s company, and government and civilian sector representatives**
- ◆ **Each has advantages and disadvantages with regard to meeting the needs of the BWC and his or her staff**



USS Coronado JOC - after recent re-design

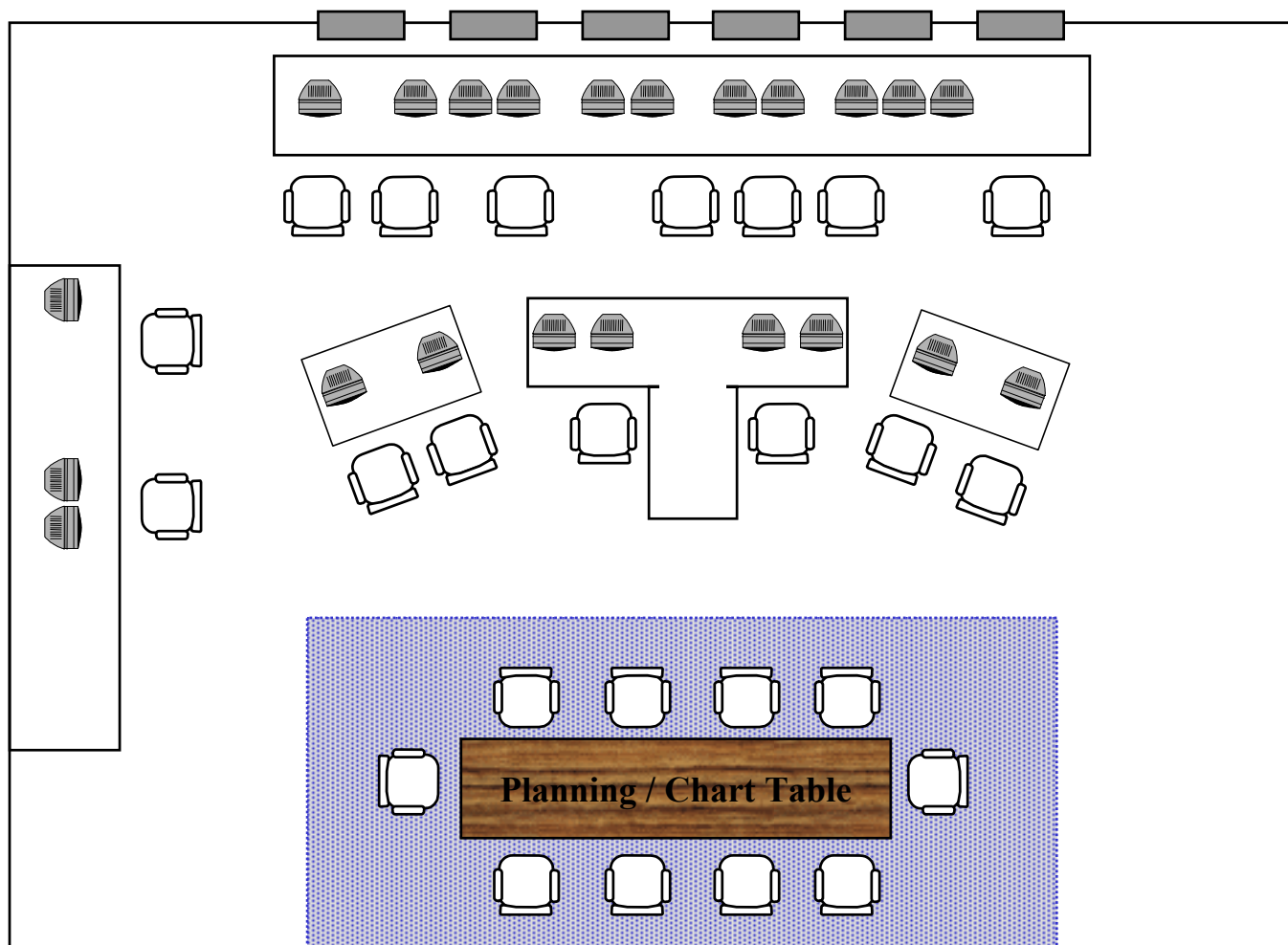
(Representative Decision Making Workspace)





USS Mt. Whitney JOC - After Recent Re-Design

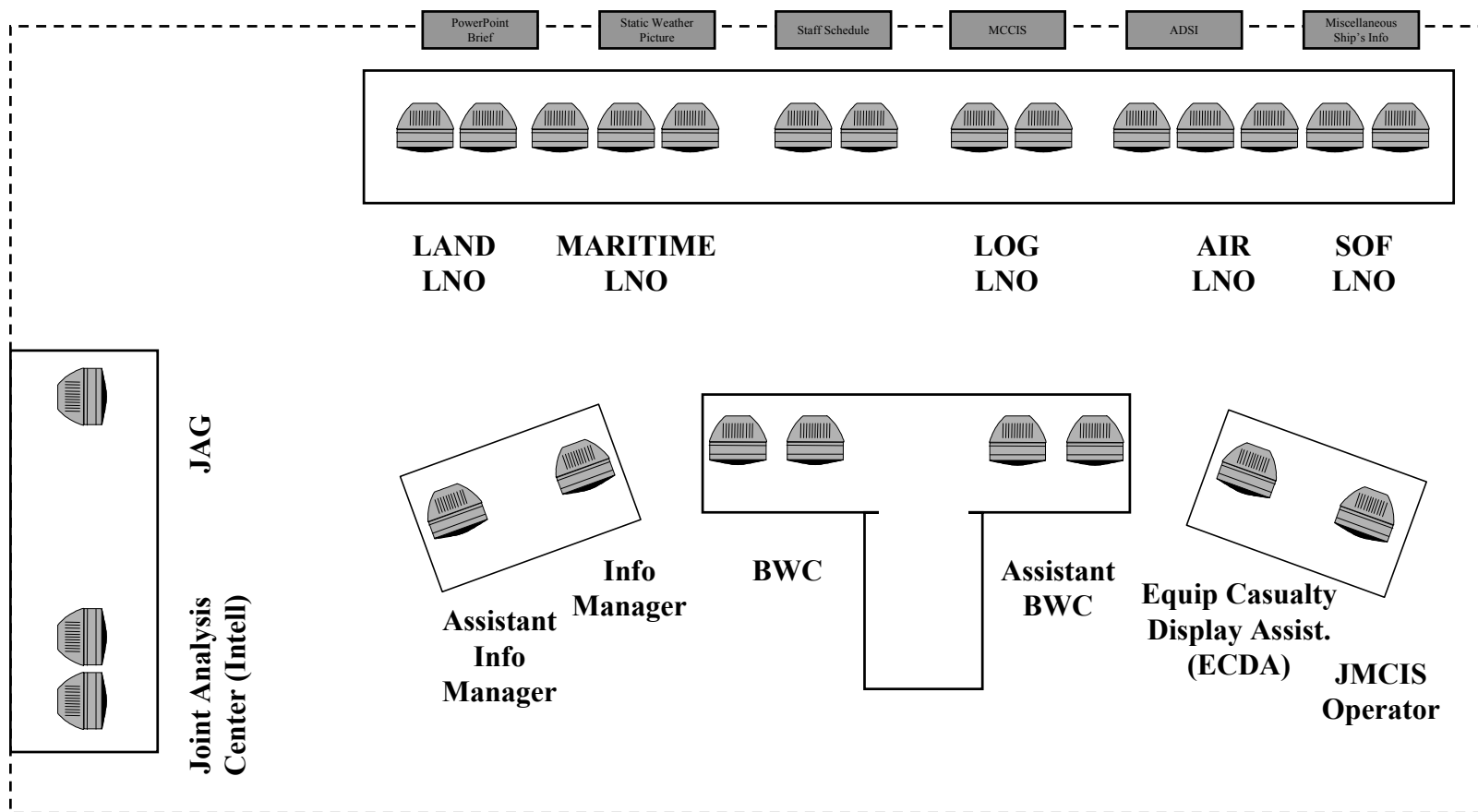
(Representative Decision Making Workspace)





USS Mt. Whitney JOC

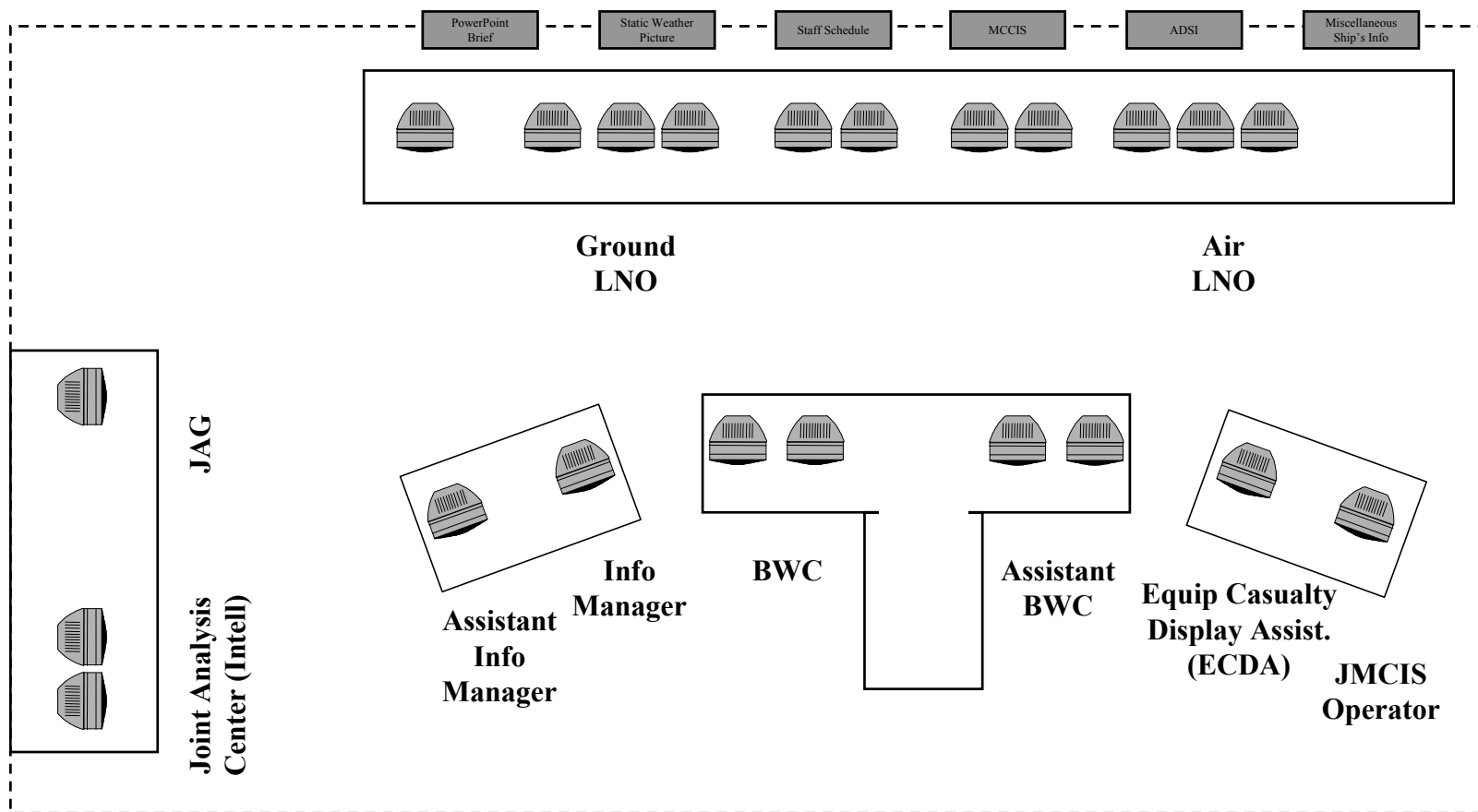
Watch Positions (as designed)





USS Mt. Whitney JOC

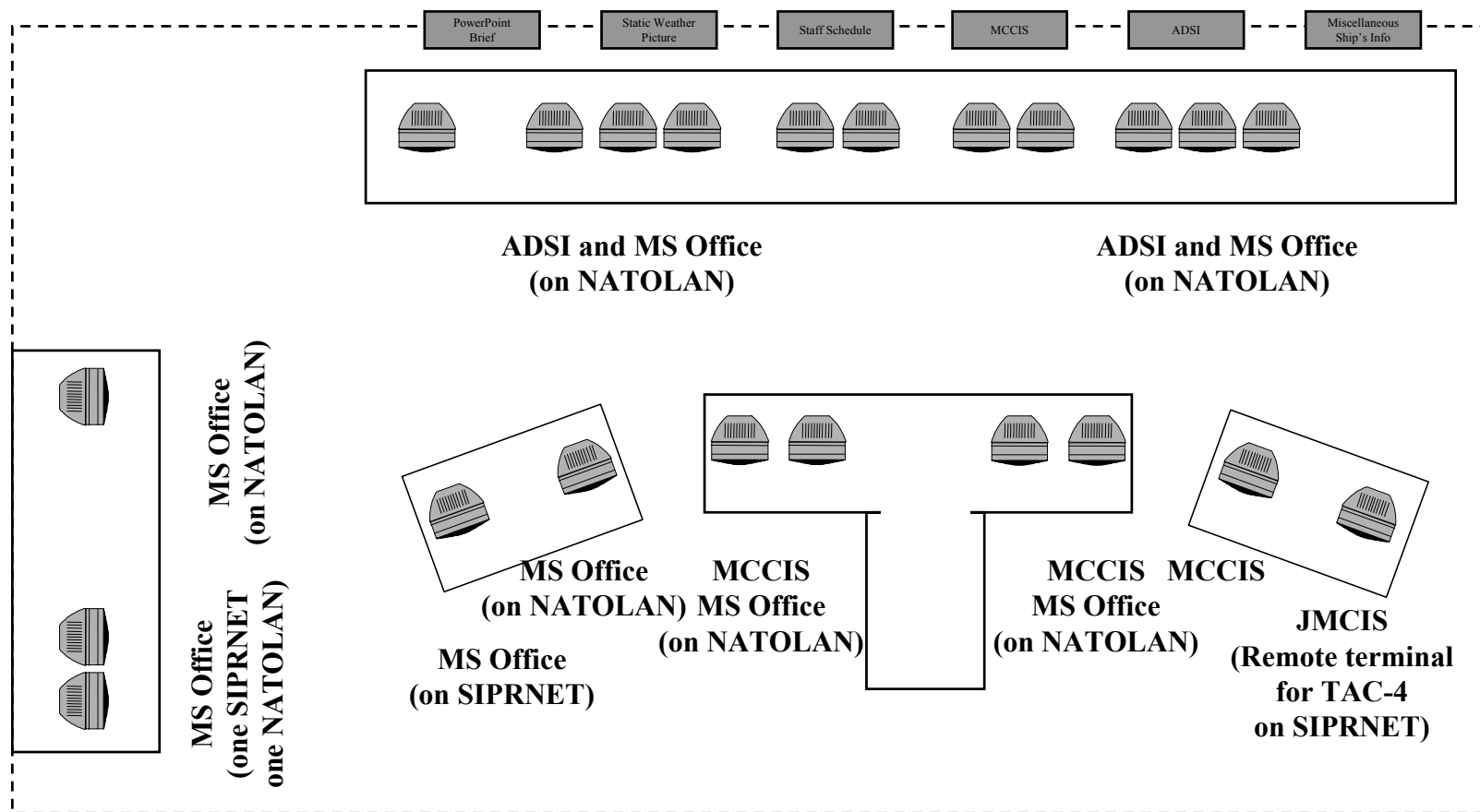
Watch Positions (as observed)





USS Mt. Whitney JOC

Console System / Display Usage

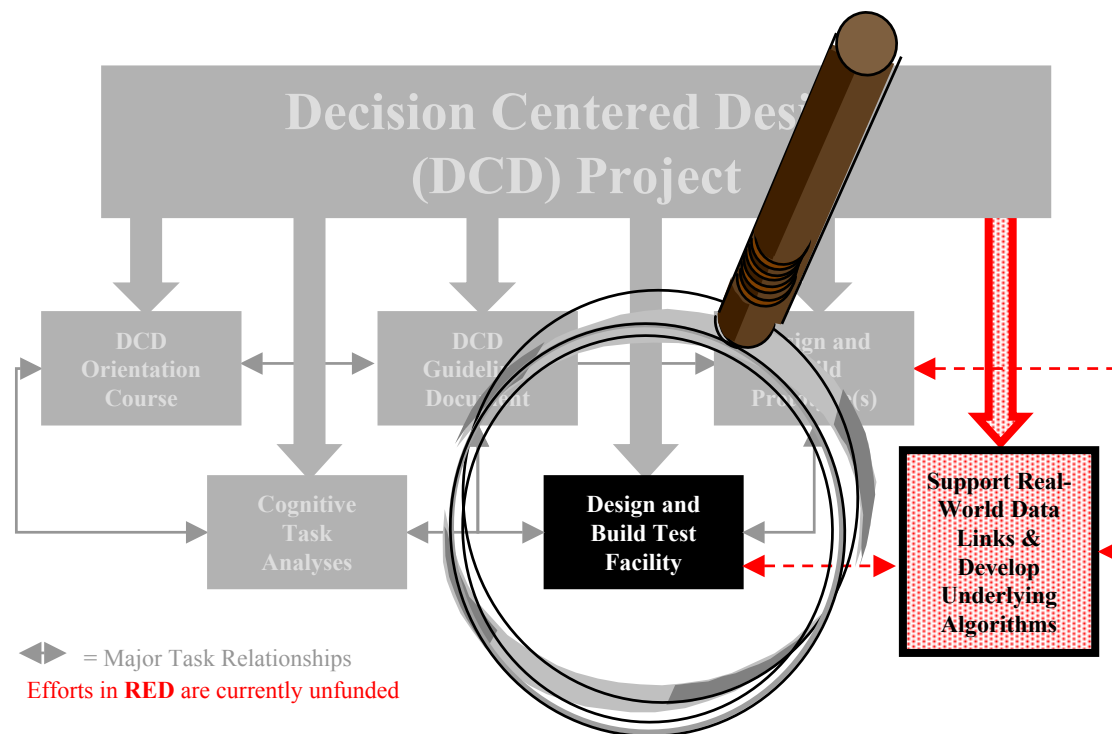






Test Facility Is Project's "Grand Stage" for DCD Process

- ◆ CTA is performed
- ◆ Prototype displays and systems are developed, tested and refined in an ongoing, evolutionary, iterative process
- ◆ Experiments are conducted to estimate performance impact of prototype display(s) / system(s)
- ◆ DCD Guidelines are validated and matured



DCD Briefs build advocacy group



Test Facility Goals

- ◆ Provide a laboratory environment *realistic enough* to accurately simulate *or* replicate real-world decision making settings
 - Provide connectivity to support “networked” operations with real-world units and be capable of “stand-alone” operations
- ◆ Provide a laboratory *flexible enough* to easily adapt to changing project needs, emerging technologies, and potential future DCD decision maker or domain “targets”
- ◆ Provide a laboratory *diagnostic enough* to collect accurate data on decision processes under controlled conditions (*in order to validate process and prototype prior to Fleet use*)



Miscellaneous Trends of Note...

(Or, *“What we need to be mindful of...”*)

- ◆ **Traditional C4ISR architecture / doctrine is evolving at a very rapid pace** (*“stand by for heavy rolls...” and “don’t bet the farm”*)
- ◆ **IT21 compatibility is a big plus...**
- ◆ **DII / COE compliance is a must...**
- ◆ **Laboratories / Test Facilities are becoming more and more “virtual” in nature** (*rather than existing at a single physical location*)
 - Often they comprise various real and simulated capabilities / systems distributed across a network; sometimes separated by great distance



Facilities / Sites Considered for DCD Collaboration or Integration

3-D Moving Volumetric Display Laboratory
Advanced Digital Network System Laboratory
Advanced Afloat Systems Human System Integration
Advanced Digital Network Services Laboratory
Advanced Prototyping Laboratory
Advanced Technology Laboratory
Applied Modeling and Simulation Laboratory
Battelle Duxbury Operations
Battelle Marine Sciences Laboratory Pacific Northwest National Laboratory
C4ISR Aircraft System Training Development Warfighter Involvement Laboratory
C4ISR Aircraft Systems Interface Development & Integration Laboratory
CCTC 140S
Collaborative Technology Laboratory
Combat Direction System Development and Evaluation Laboratory
Combat Direction System Development and Evaluation Site 360
Combat Identification Laboratory
Command and Control Processor C2P Rehost
Command and Control Technology Center 140 South
Command Center of the Future
Command Laboratory

Common Operational Modeling, Planning & Simulation Strategy Laboratory
Decision Evaluation Facility for Tactical Teams Laboratory
Dual Use Application Program Laboratory
F-14D Weapon System Integration Center Laboratory
Global Positioning System, Central Engineering Activity
Ground Combat Simulation Laboratory
High Data Rate Mobile Internet Facility
Human System Interface Technology Laboratory
Information Access Technology Laboratory
Information Exchange System Baseband Satellite Communications
Information Technology for the 21st Century Integration Test Facility
Information Warfare Systems Engineering Multi-Level Security Laboratory
JICF
JMCIS (multiple laboratories)
Land Based Test Facility
Logicon's Modeling, Simulation, and Analysis Center
LPD-17 RCS Test and Integration Facility
MAGTF Marine Air-Ground Task Force Tactical Warfare Simulation Laboratory
Multi-Link Display System Laboratory
NSWC - ICSTF
Naval Tactical Command Support System Laboratory

Naval Tactical Command System - Afloat Laboratory
Navigation Systems Sensor Interface Support and Development Laboratory
Network Technology & Integration Laboratory
Open Systems Engineering Laboratory
Range NTDS Laboratories
Reconfigurable Coalition Interoperability Laboratory
Reconfigurable Land-Based Test Site
Research, Evaluation, Simulation, Analysis Laboratory
Shipboard Electronic Systems Evaluation Facility - San Diego
Signals Warfare Integrated Facilities Test Bed
SNAP III NTCSS UNIX TAC-3 TAC-4 Laboratory
Speech Technology Laboratory
SSAT&E
Surveillance, Test, and Integration Center Laboratory
Systems Integration Laboratory
Systems Integration Facility
Tactical Advanced Computer Project Office
Virtual Prototyping Virtual Reality Simulation Laboratory
Visualization Image Processing and Virtual Environment Laboratory



Criteria Considered to Select Candidate Facilities / Sites

- ◆ **Similar Purpose / Focus on relevant domain** (e.g., tactical or operational decision-making, planning operations, military vs. civilian, etc.)
- ◆ **“Real” vs. imagined or proposed existence / capabilities**
- ◆ **Technologically compatible**
- ◆ **Location / Availability**
- ◆ **“Political value”**
- ◆ **“Fit” with DCD purpose / goals / needs**
- ◆ **Amount of information available on site**



Related/Similar Facilities

(Offer redundant and/or complimentary features)

- ◆ **Advanced Concepts Site [ACS]**
- ◆ **Advanced Prototyping Laboratory [APL]**
- ◆ **Combat Direction System Development and Evaluation Sites [CDES 118] [CDES 360]**
- ◆ **Ground Combat Simulation Laboratory [GCS]**
- ◆ **Research Evaluation Simulation Analysis Laboratory [RESA]**



“Enabling” Labs / Facilities

(Capable of providing necessary capabilities / links / technologies)

- ◆ Advance Digital Network System Laboratory
[ADNS]
- ◆ Advanced Technology Laboratory
[ATL]
- ◆ Applied Modeling and Simulation Laboratory
- ◆ Collaborative Technology Laboratory
[CTL]
- ◆ Command Laboratory
[CMD LAB]
- ◆ Common Operational Modeling, Planning & Simulation Strategy Laboratory
[COMPASS]
- ◆ Data Links Laboratory
- ◆ Defense Simulation Internet / DSI Advanced Simulation Laboratory [DSI/DASL]
- ◆ Human System Interface Technology Laboratory
[HuSIT]



“Enabling” Labs / Facilities (Cont.)

(Capable of providing necessary capabilities / links / technologies)

- ◆ Information Technology for the 21st Century Integration Test Facility
[IT21 ITF]
- ◆ Joint Maritime Command Information System (JMCIS) Ashore and Afloat/ JAVA Engineering Development and Integration Facilities
[JMCIS Ashore/JEDI]
- ◆ Network Technology & Integration Laboratory
[NTIL]
- ◆ Systems Integration Facility
[SIF]
- ◆ Systems Integration Laboratory
[IRUS] *(including IRUS II)*
- ◆ Visualization Image Processing and Virtual Environment Laboratory
[VIPER]
- ◆ Multi-Modal Watchstation Laboratory



Candidates for Formalized Test Facility “Partnerships”

- ◆ **Advanced Concepts Site (ACS)**
- ◆ **Combat Direction System Development and Evaluation Sites (CDES sites)**
- ◆ **Command Center of the Future (CCOF)**
- ◆ **Decision Centered Combat Operations Center (DC-COC)**
- ◆ **Decision Evaluation Facility for Tactical Teams (DEFTT)**
- ◆ **Research Evaluation Simulation Analysis Laboratory (RESA)**
- ◆ **Systems Integration Laboratory (IRUS)**
- ◆ **Multi-Modal Watchstation Laboratory**

Part IV: DCD “Virtual Laboratory” - *Test Facility Plan*

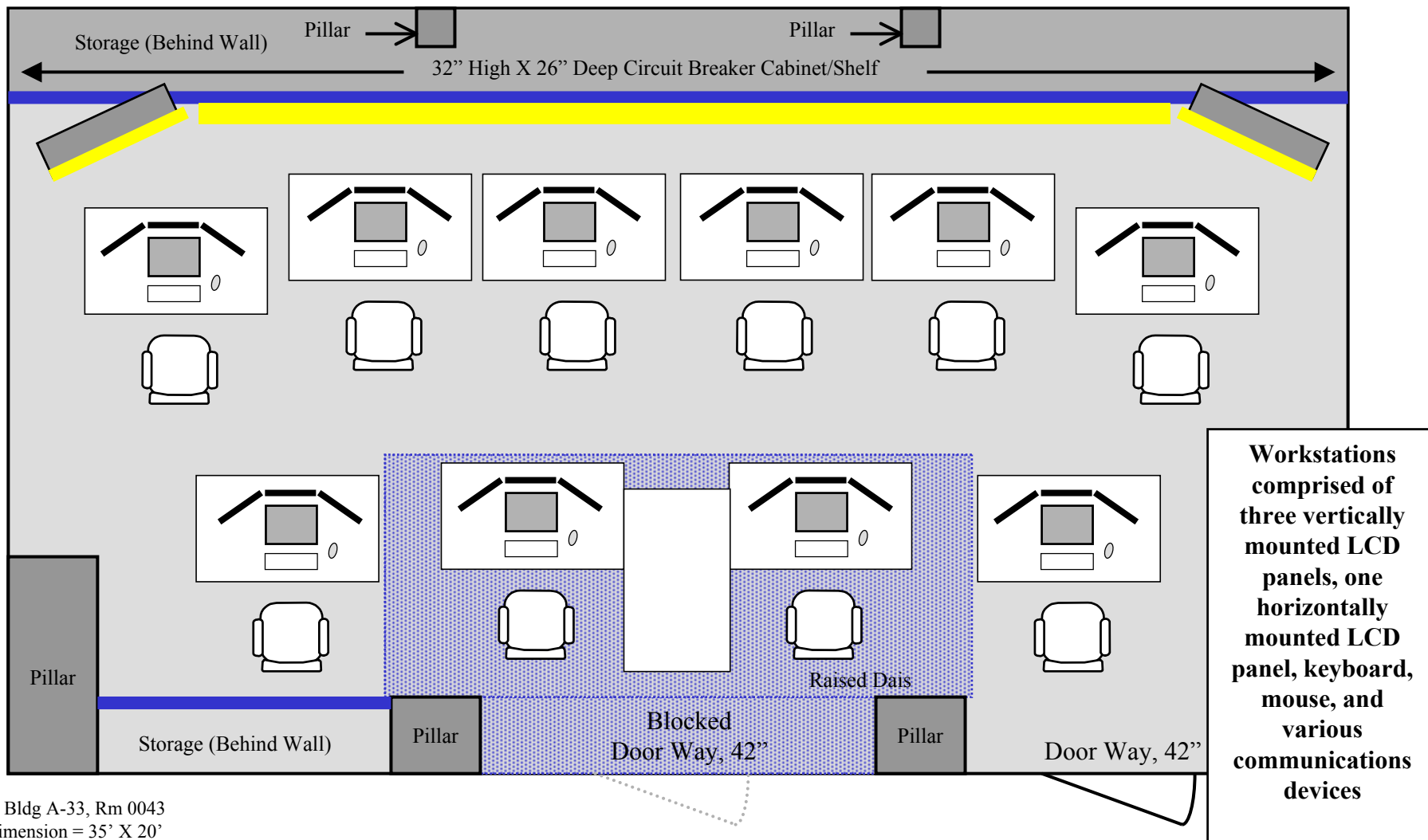
What shall we build?

How shall we proceed?



The Concept...

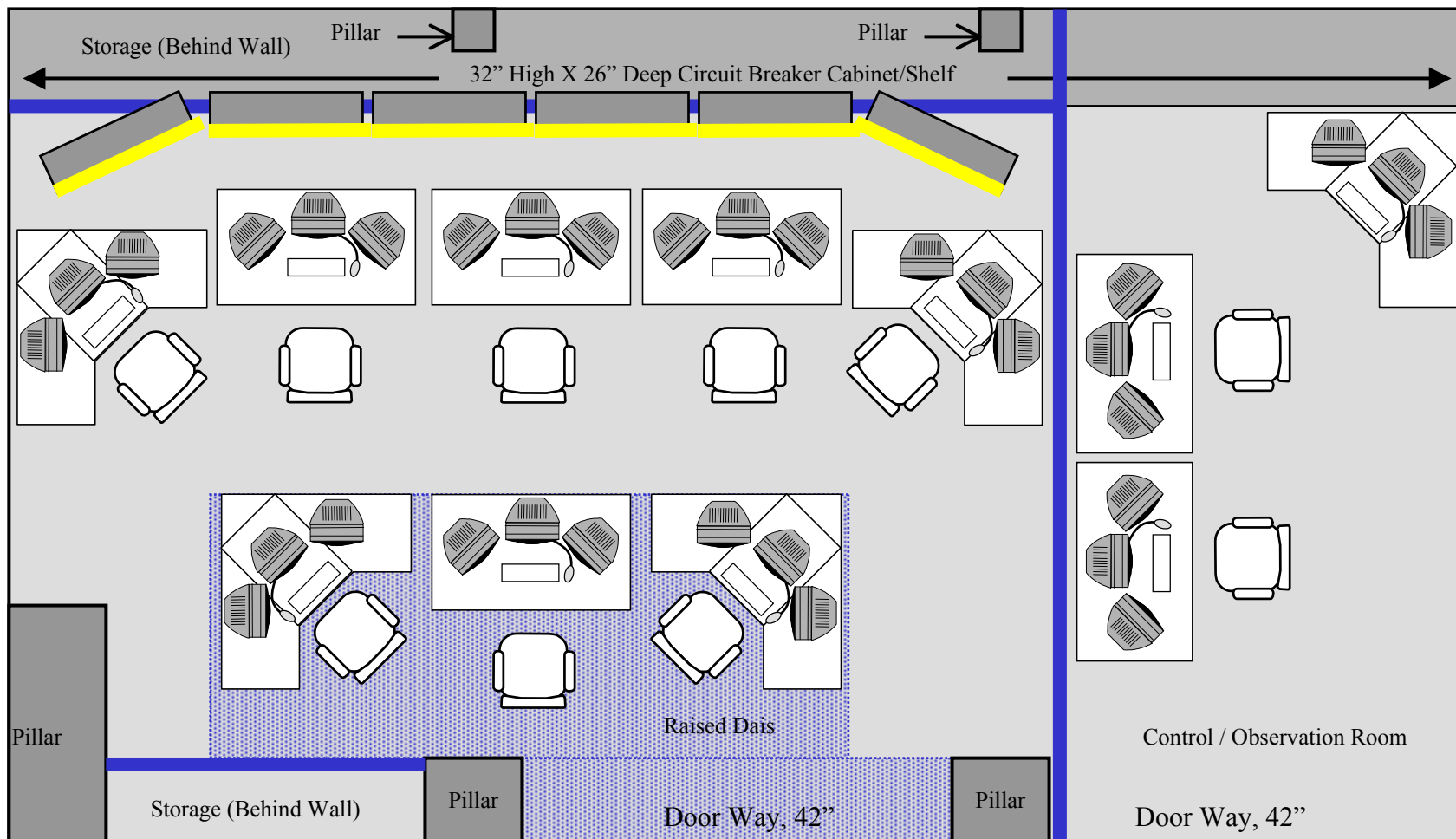
Proposed Test Facility Layout





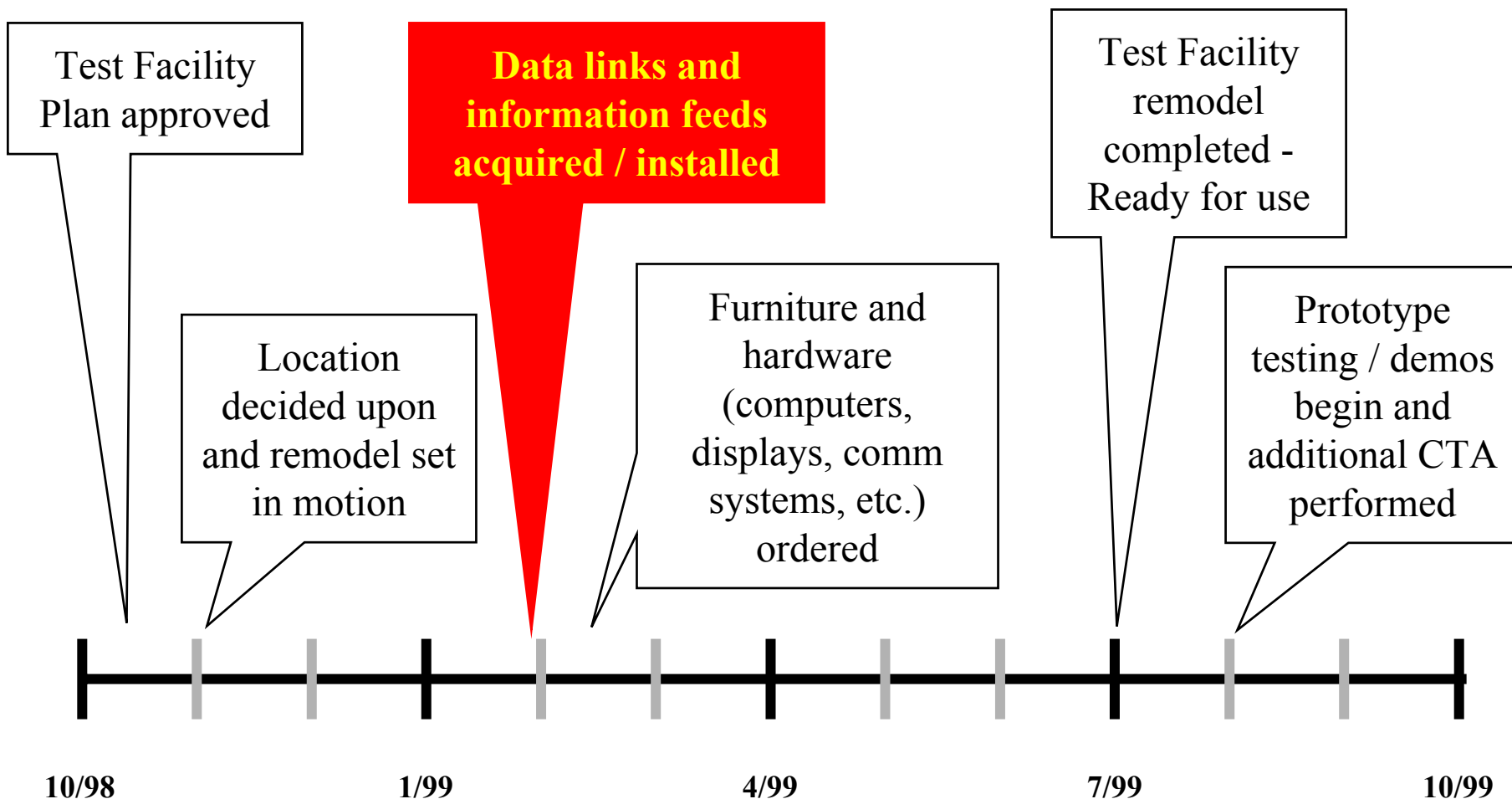
The Reality?

Proposed Test Facility Layout





Proposed Test Facility Implementation Time Line



Efforts currently unfunded and/or status uncertain



Required Data and Communications Equipment / Feeds

◆ Radio Communications *(representative only - necessary hardware could support various circuits)*

- Navy Red
- Surface
- CJTF Blue / JFACC Liaison
- SATHICOMM
- BG Command
- JFACC Command
- ARG Command
- Miscellaneous C&R Nets

◆ Other Communications

- Secure and Unsecure Telephone
- JMCIS *and / or* MCCIS
- ADSI
- VTC
- E-Mail
- NIPRNET / SIPRNET / NATOLAN
- IRC (*Internet Relay Chat*)
- COMPASS
- Television (CNN / HNN)



Required Hardware / Software

Hardware

- ◆ Ten “high-end” IT-21 computer systems capable of “driving” four 1024 X 768 displays; each system having VTC capability
- ◆ Forty 15” or 17” LCD panels
- ◆ One “data wall” and two 50” LCD rear projection monitors OR six 50” LCD rear projection monitors
- ◆ Two PictureTel VTC systems (or similar) fed to large monitors
- ◆ Two (or more) television receivers (i.e., VCRs) - fed to large monitors
- ◆ Two STU-III (or STU-IIB) secure telephones
- ◆ Ten multi-line telephones
- ◆ Minimum of two HF / VHF / UHF transceiver sets
- ◆ Minimum of two secure transceiver sets
- ◆ Multi-port Ethernet hub connected to NIPRNET or SIPRNET (depending on ops)

Software

- ◆ Prototype Display Software
- ◆ MS Office
- ◆ Screen Capture Software
- ◆ IRC Software
- ◆ VTC Software



Part V: Conceptual Display Suite and Its Planned Use

What will the CJTF DSS look like?

How will we use it?



CJTF DSS Conceptual Design

*Common design features across numerous task-customized workstations
(e.g., BWC, Anchor Desks, CJTF, etc.)*

**Multi-Purpose Collaborative
Workspace and Tools (Anchor
Desk Overlays, Screen Capture
Utility, IRC, VTC, Whiteboard,
etc.)**

**Anchor Desk / LNO and
Component Commanders'
Status Boards**

Geo-Plot and Tools

**“Workbench” Tools (web
browser, MS Office
Applications, e-mail, Auto-
dialer and facsimile to POTS
and STU-III, Voice Log, etc.)**

**Multi-Circuit
Comms Panel
(Secure and
Un-Secure Radio R/T
Circuits)**

Basis for Assessment Interface

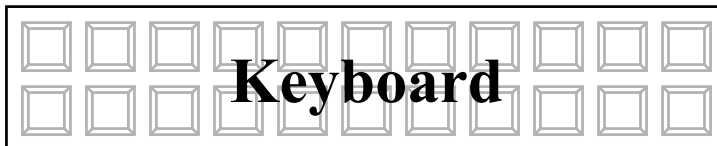
**2nd Generation JTF-Level
Response and Action Manager
and Planner (RAMP)**

Left-most and
right-most
displays angled
30° toward user

**STU-III
Phone**

**POTS
Phone**

(Lower display
inset horizontally
into work
surface)

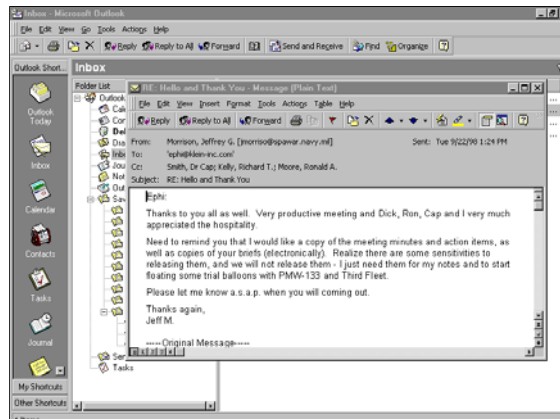
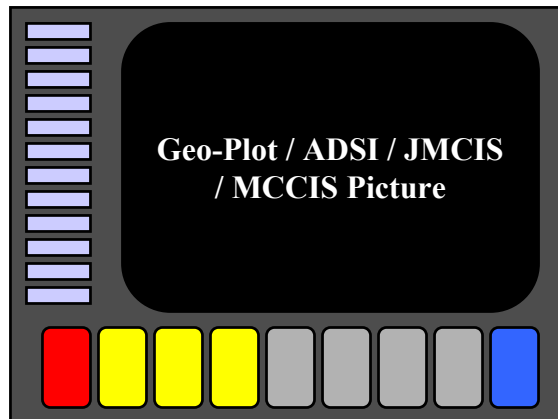
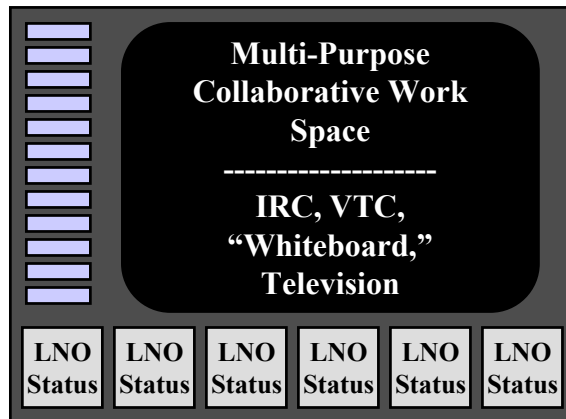


Mouse Area

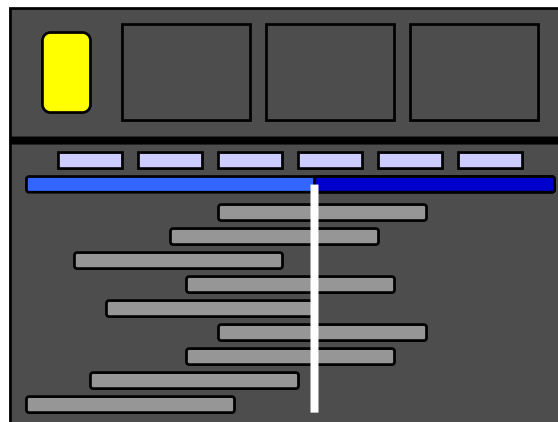


CJTF DSS Conceptual Design

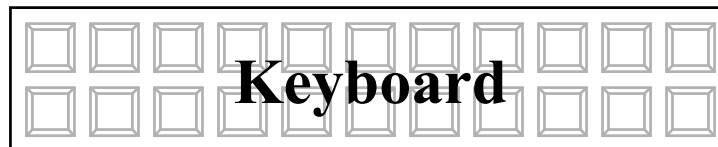
Common design features across numerous function- and task-customized workstations (e.g., BWC, Anchor Desks, CJTF, etc.)



Communications
Access Panel
(Secure and
Un-Secure Radio R/T
Circuits)



(Lower display
inset horizontally
into work
surface)



Left-most and
right-most
displays angled
20° - 30° toward
user

STU-III
Phone

POTS
Phone



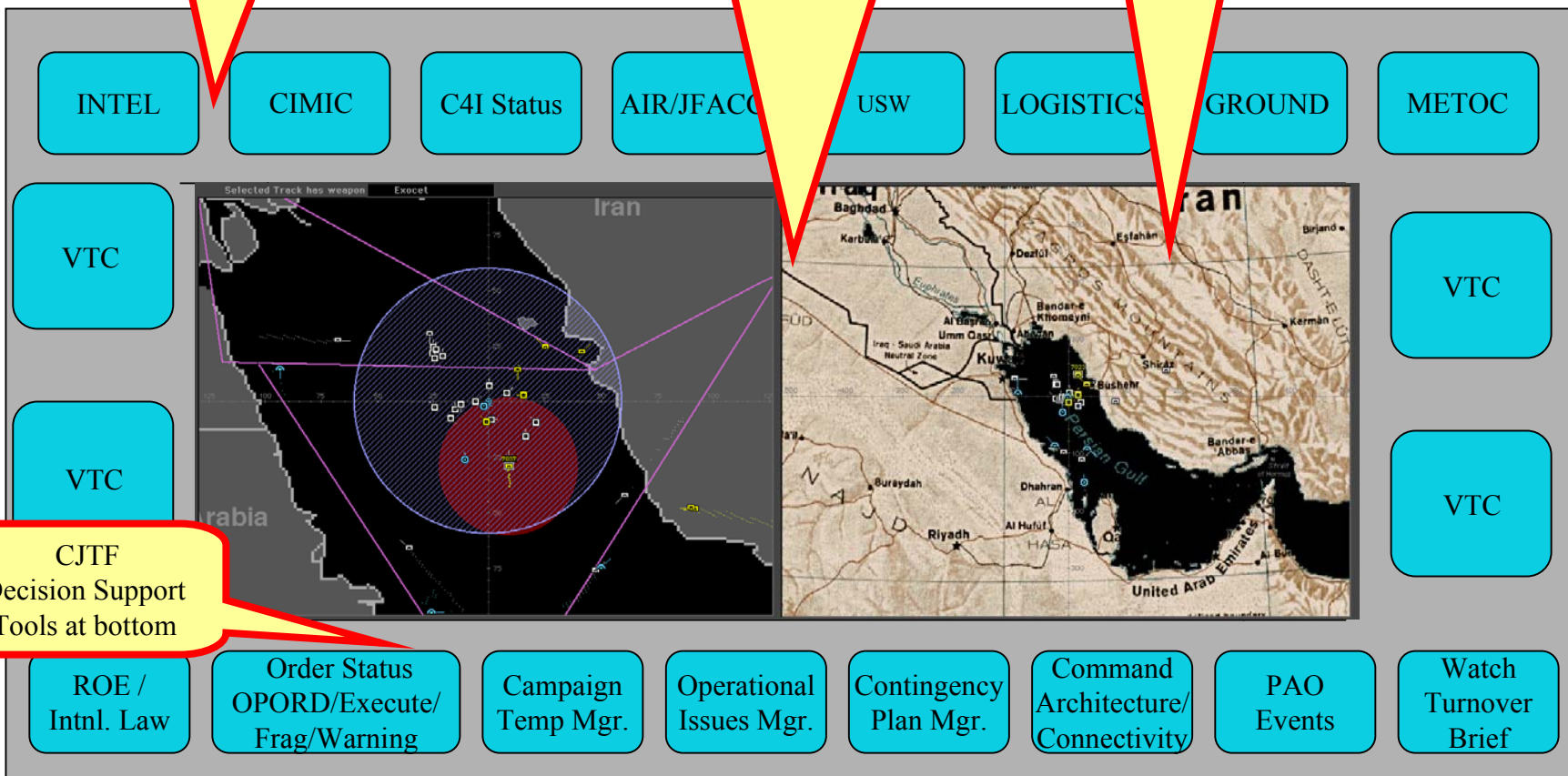


Conceptual CJTF Collaborative Decision Support System: A “Picture Window” into a “sea of information” displayed using a 4096x2304 “data wall” & fed from Anchor Desk DSS’s.

CJTF Anchor / LNO
Desks Summary Displays
across top.

BWC would swap perimeter displays in and out of
large collaborative displays through voice and/or
gesture commands

Large workspaces for
collaborative decision making -
amplify on summary displays
in perimeter

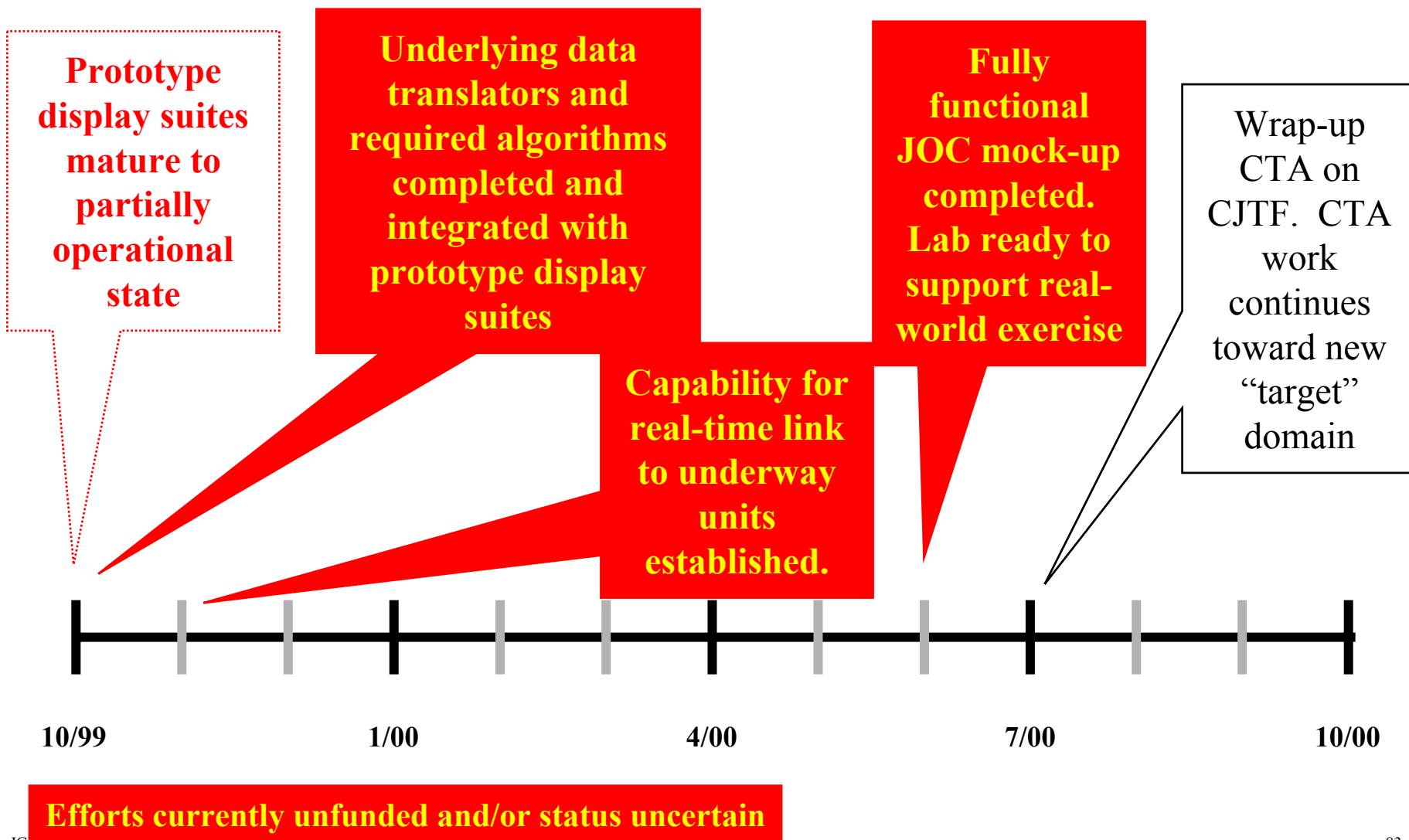


CJTF
Decision Support
Tools at bottom



DCD Test Facility

Proposed T & E and CTA Schedule





Conclusion

Decision Centered Design

An approach to system design for tactical decision makers which is:

Applicable To ALL C2 Systems,

Enables Network Centric Warfare,

Key to Achieving True Speed of Command.